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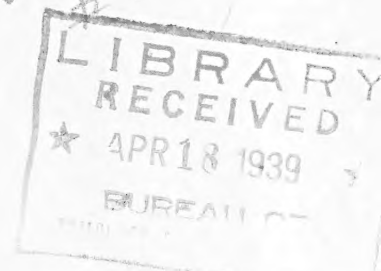
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POSSIBILITY OF DISSEMINATING THE PINK
BOLLWORM (PECTINOPHORA GOSSYPIELLA
(SAUNDERS) BY FLOOD WATERS

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Two floods from the Rio Grande occurred at Presidio, Tex., in September and October 1932, which covered some 4,500 acres of land planted to cotton, and carried out of the valley thousands of green and open bolls and 31 bales of seed cotton, heavily infested with pink bollworm larvae, that had been piled in the fields. After these floods the question arose as to the possibility of the infested material being carried to other cotton districts to establish this serious pest in new areas down the river. Tests which form the basis of this paper were conducted in October and November 1932 by the writer and L. C. Fife. The recent floods of the Rio Grande in July and September of 1938 again provided a means of further dissemination of infested cotton and make it seem timely to present the data on hand in regard to the possibility of dissemination of the pink bollworm by flood waters.

Methods.---Green and open cotton bolls heavily infested with pink bollworms were gathered from the field on October 25, 1932, and immediately placed in water. Approximately 200 green and a like number of open bolls were placed in a large metal bucket and a weighted board placed on them so that they would be continuously submerged. A similar number of green and open bolls were placed in large metal tubs, partially filled with water, so that each boll would float free. After 24 hours 20 bolls were taken from each treatment and carefully examined so that all larvae would be recovered. After the larvae were removed from the bolls they were placed in small stender dishes and left overnight in a room at a constant temperature of 80° F. The following morning they were examined to determine the number that were alive and the number that were dead. Only those that appeared fully recovered and normal were recorded as being alive. Although 24 hours is frequently used in this paper as the time allowed for larvae to become active or lifelike after their removal from the bolls, this was an arbitrary time set for examining the larvae and is so used. In all probability revival of larvae began within a few hours after their removal from the bolls.

Subsequent examinations were made daily of samples from each treatment until all the bolls had been examined. Daily notes were also made on the number of bolls remaining afloat in the floating-boll series. Unfortunately, sufficient bolls had not been put in the water to enable the test to be carried on as long as was later found desirable, but the number was sufficient to give considerable information.

SURVIVAL IN GREEN BOLLS

Floating bolls.---Live pink bollworm larvae were recovered from floating green cotton bolls each day over a period of 16 days (table 1). From the first to the eighth day after the experiment was started more than 50 percent of the larvae recovered were alive, whereas from the tenth until the sixteenth day there were many more larvae dead than alive. On the sixteenth day 6 of 36 larvae were found to be alive. The number of green bolls that sank over any 24-hour period ranged from none to 18. On the sixteenth day seven of the eight remaining bolls were afloat. Loftin, McKinney, and Hanson (U.S. Department of Agriculture Dept. Bull. 918) conducted similar experiments in Mexico and found that green bolls floated and larvae remained alive for 10 days, but on the eleventh day all bolls sank and no live larvae were found.

Submerged bolls.---Live pink bollworm larvae were found in submerged green bolls each day through the ninth day. On the tenth and eleventh days no live larvae were recovered from a total of 38 specimens removed on these two days (table 1). From the third to the sixth day the numbers of live and dead larvae were practically equal, but on the seventh day and each succeeding day thereafter the dead greatly outnumbered those alive. After the third day practically none of the larvae showed any signs of movement immediately on removal from the boll, but when left 24 hours at a temperature of 80° F. the ones that revived appeared to be perfectly normal.

SURVIVAL IN OPEN BOLLS

Floating bolls.---Live pink bollworm larvae were recovered from floating, open bolls each day for 12 days, or as long as examinations were made (table 1). On the twelfth day 9 of 34 larvae were found to be alive. Of the larvae recovered on the eighth day 58.8 per cent were alive and on the tenth day nearly 43 percent of those recovered were alive. A few larvae appeared alive immediately following their removal from the bolls each day for eight days, but from the ninth to the twelfth day none of the larvae appeared to be alive until 24 hours after removal. The number of open bolls that sank each day was much less than the number of green bolls under similar conditions. It is quite probable that a much longer survival would have been recorded for larvae in open bolls had sufficient bolls been available for continued daily examinations.

Submerged bolls.---Live pink bollworm larvae were also found in submerged, open bolls until the last examination on the 12th day (table 1). More than half the larvae were alive until the seventh day, after which the mortality increased rapidly, and only 2 of 43 larvae were found alive on the twelfth day. Very few of the larvae appeared alive immediately after their removal from the bolls, even

during the first 2 or 3 days, but at that time many would respond to a heat stimulus. Some of those that did recover and appeared normal did not do so until after 24 hours. Loftin et al. (op.cit.) found that larvae pupated and produced adults after 7 days in floating and submerged open bolls but that no adults emerged after 11 days in either case. On the other hand, Ohlendorf (U.S. Department of Agriculture Dept. Bull. 1374), working in Mexico, buried infested bolls and seed in the soil in small plots and 90 days later found 0.06 percent of the larvae alive after they had been completely covered with water for 64 days. He also found 0.2 percent of the larvae alive in open bolls and seeds that had floated on the water for 40 days, and pupae were found on the surface of the soil after larvae had been buried and covered with water for 18 days.

Discussion.--It has been estimated by the United States Boundary and River Commission that the speed of flood waters in the Rio Grande will average approximately 5 miles per hour. Considering that the length of the Rio Grande from Presidio, Tex., to the Gulf of Mexico is roughly 1,500 miles, it would require 300 hours for a boll of cotton to reach the gulf if there were no obstruction to its travel. Thus it may be seen that with records of bolls remaining afloat for at least 16 days, or 384 hours, and pink bollworm larvae remaining alive in these bolls, there is a possibility of the larvae being carried considerable distances into the Gulf. Steps were taken by R. E. McDonald immediately after the 1932 floods to determine the possibility of infested cotton being carried to uninfested areas. Inspectors of the Pink Bollworm and Thurberia Weevil Control Project and of the Port and Border Service were stationed at Del Rio, Eagle Pass, Laredo, and Zapata, Tex., at the time of the September 1932 flood to make observations as to whether cotton products were being carried down the river, but none were observed at any of the above places. During the October 1932 flood, inspectors followed the crest of the flood to Brownsville, Tex., but no cotton material was found south of Lajitas, in Brewster County. Considerable numbers of live pink bollworms were found in cotton and bolls collected among the flood debris within the Presidio section during October after the flood had subsided. Inspection was continued during November from Eagle Pass to Langtry, Tex. The only cotton found was several stalks in the vicinity of Eagle Pass, and it was later demonstrated almost conclusively that these plants came from flooded fields near Jiminez, Mexico, which is up the river from Eagle Pass.

Although these inspections do not indicate that cotton was carried for any considerable distance by the flood waters of the Rio Grande, the fact that larvae can survive in bolls in water for sufficient time to be carried by the river to the Gulf and the discovery of the pink bollworm in the Lower Valley 5 years after the floods present an interesting series of circumstances for speculation. In all probability it will never be definitely known whether the infestation in the Lower Valley was started by infested material carried by floods

from the Big Bend, but that the possibility exists is evident.

Summary.--Pink bollworm larvae survived in green bolls submerged in water for 9 days, in open bolls either submerged or floating for 12 days, and in floating green bolls for 16 days. Indications are that an even longer survival would have been recorded had sufficient material been used for a continuation of the experiment. Open bolls are more buoyant than green bolls and a larger percentage remained afloat longer. Flood waters of the Rio Grande are estimated to reach the Gulf from Presidio in 300 hours. No cotton or cotton products were found by inspection to have been carried outside the Big Bend area by the river, and the fact that live pink bollworms in cotton bolls have been carried by floods and have started new infestations is not definitely established.



Open Bolls										Green Bolls										Total
Submerged					Floating					Submerged					Floating					number
No. of Days	Total Larvae	No. of Larvae Alive	Per-cent Alive	Total Larvae	No. of Larvae Alive	Per-cent Alive	Total Larvae	No. of Larvae Alive	Per-cent Alive	Total Larvae	No. of Larvae Alive	Per-cent Alive	Total Larvae	No. of Larvae Alive	Per-cent Alive	of Bolls in each class examined				
1	55	27	49.1	96	93	96.9	45	39	86.7	82	78	95.1	82	78	95.1	20				
2	87	58	66.7	107	100	93.5	88	75	85.2	85	53	62.4	85	53	62.4	20				
3	101	52	51.5	90	69	76.7	92	41	44.6	88	57	64.8	88	57	64.8	20				
4	68	41	60.3	52	38	73.1	65	31	47.7	79	41	51.9	79	41	51.9	20				
5	84	55	65.5	96	72	75.0	92	49	53.3	81	64	79.0	81	64	79.0	20				
6	100	69	69.0	67	52	77.6	85	46	54.1	56	30	53.6	56	30	53.6	20				
7	90	47	52.2	60	22	36.7	75	29	38.7	72	51	70.8	72	51	70.8	20				
8	87	37	42.5	80	47	58.8	73	17	23.3	69	36	52.2	69	36	52.2	20				
9	64	20	31.3	37	13	35.1	38	8	21.1	69	32	46.4	69	32	46.4	10-20				
10	51	8	15.7	42	18	42.9	29	0	0.0	68	20	29.4	68	20	29.4	10-20				
11	38	9	23.7	31	12	38.7	9	0	0.0	42	9	21.4	42	9	21.4	3-10				
12	43	2	4.7	34	9	26.5				43	3	7.0	43	3	7.0	9-10				
13										31	3	9.7	31	3	9.7	10				
14										59	7	11.9	59	7	11.9	14				
15										38	5	13.2	38	5	13.2	8				
16										36	6	16.7	36	6	16.7	8				

